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Chemicals and Clover

SUCCESSFUL FARM OPERATIONS WHERE HIGH-GRADE COMPLETE
MANURES AND SOD SUPPLY A CHEAPER MANURE THAN
THAT OBTAINED FROM KEEPING LIVE STOCK.

H. W. COLLINGWOOD.

THE RURAL PUBLISHING CO., TIMES BUILDING, NEW YORK.

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OR

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Complete Manures and Sod supply a Cheaper Manure
than that obtained from keeping Live Stock

BY

HERBERT W. COLLINGWOOD

Managing Editor of The Rural New-Yorker.

NEW YORK

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INTRODUCTION.

SINCE the publication of a few crude articles on "Chemicals and Clover" in *The Rural New-Yorker*, many requests have come to me for further information respecting the details of this unique system of farming. I have therefore elaborated and expanded those articles, in the hope of making the matter clearer. One can be easily misunderstood on such a subject. Chemical manures have a certain place in American agriculture. Like anything else of real value, their *use* will bring profit—their *abuse* will bring loss. Chemicals and sod supply every element that is supplied in stable manure. That fact cannot be disputed by any thoughtful man. On some farms the chemicals are cheaper than the manure. What I have attempted in this little book is to give an idea of what these farms are and how they may be found. *The Rural New-Yorker* has frequently been accused of "talking fertilizers too much." We have not "talked about" them half enough. The farmers of this country pay out each year over \$50,000,000 for commercial fertilizers. A good deal of this money is lost and wasted because poor and unsuitable goods are bought, and because they are wrongly used. One reason for these mistakes is that fertilizers are not "talked about" as they should be. I *know* that on a good many Eastern farms grass-sod and chemicals make a better and cheaper "dressing" than stable-manure. On many other farms smaller quantities of fertilizers added to the present stable-manure will pay a double profit because they might be used to supply what the soil needs and what the manure lacks. I also know that some farmers are making

stable-manure at a loss—that is, the hay and grain fed to stock and the labor spent in feeding them, cost more, after the resulting meat, milk or wool is sold, than the same amount of “fertility” would cost if bought in the form of fertilizers. There are thousands of farmers who spend all the way from \$500 to \$1,200 in cash for fertilizers each year. They are, almost without exception, highly successful—making money at farming while their farms are of good heart and constantly growing heartier. How did they learn to farm in this way? By “talking fertilizers” and thinking fertilizers. They made mistakes and failures and might have stopped several times and said, “Fertilizers don’t pay.” They stuck to the use of them long enough to learn that the way to use fertilizers with profit is to have them in a rotation in which grass-sod plays a prominent part. I know farmers who talk politics by the hour without adding the weight of a straw to the safety of the country, or changing in any way the political situation. If they would spend that time *talking the truth out of fertilizers* they would *do something*. The meat of this fertilizer question has a tough shell around it. The shell of that nut can be cracked only by the hammer of thought, but the meat inside is well worth the cracking. While there may not be much that is *new* about this farming with Chemicals and Clover, there is, however, much that is *true*, and if there ever was a time when American farmers needed to work out the truth of this question of farm fertility, it is *now*!

Chemicals and Clover.

I HAVE a plain story to tell and shall try and waste no words in telling it. I ask the reader in advance to remember that the statements that follow are all founded on facts which can be readily verified. I make this assertion thus early because I know how hard it is for many farmers to realize that such a thing as "artificial dung," or I may say concentrated manure, is possible, or that the crops of an ordinary farm rotation can be successfully grown without feeding all or most of the grain and hay to live stock. Countless reasons have been given for the failure of American agriculture to pay a reasonable profit for the farmer's toil and care. One great reason for the decline of farming in the older parts of the country is rarely mentioned by the agricultural surgeons. It is the simplest and most evident to the scientific man, and the most obscure to the "practical" man who has lived long enough to wear a comfortable rut for himself in everyday affairs. This reason is a well-established belief, handed down from father to son, that there is no real substitute for stable-manure, and that land which can not support live stock of some sort at a profit must be "abandoned" or farmed at a loss. It is evident that the recent rapid development of the West, and the wonderful increase in transportation facilities, have tended to reduce the cost of meats and live stock products, until the Eastern farmer can not compete on even terms with his Western competitor. He must secure a special price by selling a special product in a special market, or conduct a losing business because he must pay cash for plant food while his competitor has 100 years the start of him in a soil that is a century younger in exhaustive cultivation. No man but an expert—one specially gifted by nature for handling live stock—can develop a special market. Are the others to quit farming when the prices of their products fall so low that stable-manure costs more than it is worth?

Several years ago a Western farmer who left New England because Western farm-products "swamped him out" said to me :

"Within 40 years the farming-lands of New England, New Jersey and Eastern New York will be reduced to the condition of a desert! The land west of the Alleghanies can produce more food than the people of the entire country can consume, and railroad transportation is being so perfected that the Western farmer can undersell the world in any market. Whenever a section of country begins to use large quantities of chemical fertilizers its agriculture is doomed—just as the man who begins the continued use of stimulents must bid farewell to health. The only natural way to maintain the fertility of the soil is through live stock husbandry. A change in that system is unnatural and means death! The future of Eastern agriculture is easy to predict. The majority of the manufacturing enterprises must, sooner or later, go to the places where their raw materials are produced. The great seaports will, of course, remain. The country for a few miles back around them will support thousands of foreign gardeners and fruit-men but, back of this narrow strip, lightning trains from the West will run through deserted farming regions given up to wilderness and desolation—with grass-grown roads, ruined churches and school-houses, and deserted villages; with sheep or cattle-ranching—the lowest form of agriculture—as the only farming."

This man believed what he said, and had some reason for his belief. I was born in New England. I go back now and find the little farm on which we made a happy if scanty living, grown up to bushes and briars—deserted because "*manure costs too much.*" There are dozens of farms like it in the township. A few farmers prosper still at raising vegetables and fruits, selling milk or keeping poultry, but the majority of the old homesteads that are not "nailed up" are rented to workers in the shoe-factory or filled with sad and bitter old people rusting in melancholy loneliness through the years that ought to be the best of their lives. No soil cost more in toil and privation than that of these New England farms. It is sad that all this labor should now yield nothing but disappointment. What is the cause? "Western competition!" What does that mean? Cheaper fertility! It means 100 per cent. less in the cost of stable-manure for the Western farmer, and a consequent doubling of the cost of maintaining the fertility of the New England farm.

That is one story; now here is another told me by a farmer in New Jersey—a section just about as old as the one in New England already alluded to.

"In 40 years from this time, the richest lands of the country will be at the East while the poor lands will be at the West. Every principle that is supplied to the soil in stable-manure can be supplied by a system of rotation in which chemical fertilizers form the basis of fertility. The crops will grow larger and larger, the soil richer and richer, and the labor less and less

exacting. The Western farmer of the future will have to perform all the drudgery of dairying and stock-keeping. The Eastern farmer need do but little of this work, but may substitute for stable-manure the easily-applied chemicals. Stable-manure is nothing, after all, but the residue of the hay and grain eaten by the animal. The same elements that make the grain valuable are found in chemicals; and the hay is practically the same, whether it is eaten or turned directly into the soil with a plow."

These statements induced me to visit Cranbury, N. J., where this system of farming with chemicals and clover has been carried on some 15 years—long enough to test all its possible weak points. I found a community of farmers growing rich at producing hay, potatoes, corn and wheat—keeping just as little live stock as possible. Yes, growing rich in direct competition with the West, and on this "unnatural" system of chemical manuring. I found happy and contented farmers, boys that want to stay on the farm, and a farm-life robbed of the disagreeable features that have driven many a bright boy and girl into the prison of a factory or store. A soil fattening while it yields fat crops—agriculture that "pays"!

First let us consider the crops grown and the rotation followed; for the rotation is acknowledged to be one of the most important elements of the system.

Four crops are grown—potatoes, wheat, grass two years, and corn. The potatoes are planted in drills with over 1,500 pounds of high-grade fertilizer to the acre, or 1,000 pounds broadcast before planting and 500 or more in the drills. The potato-ground is plowed and seeded to wheat in the fall with Timothy, with clover added in the spring. After two years of grass what stable-manure is made is hauled out in summer and spread on the sod—the aftermath being permitted to grow and decay on the ground. This is all plowed in the spring and the ground is planted to corn, to be followed the next spring by potatoes, and so on through the rotation. The theory of this system of fertilizing is that the heavy dressing of potato-fertilizer will not only produce a profitable crop of potatoes, but will leave enough fertility in the soil to maintain the wheat and grass. The stable-manure and clover sod are used for the corn, because corn is the great scavenger of the farm—better able to appropriate the coarser manures than any of the other crops. It has a longer life, a better digestion, and a stouter heart than any other crop in the rotation. As little stock as possible, outside of the work-teams, is kept, and no particular pains are taken to increase the amount of stable-manure.

Trusting Their Money to Potatoes.

Mr. D. C. Lewis is the pioneer (at Cranbury) of this unique system of farming, and his farm is about the best illustration of the possibilities of

chemical manuring. He has 100 acres, including woodland, pasture and house-lot. Last year's (1891) potato-field contained 17 acres. On this one field there were applied 107 bags or 21,400 pounds of high-grade fertilizer, costing a little over \$450 in cash. In former years the fertilizer was all applied at planting, but this year a portion was reserved for the first cultivating. It was put on with the drill and immediately cultivated in. Mr. Lewis believes that this second dressing not only gives the potato-roots a better chance to grow and stretch out for their food, but that it gives a better distribution of the fertilizer for the wheat which is to follow. The potato is the best crop on which to use the fertilizer, for several reasons. It is a heavy feeder and needs its food in a soluble form, as the growth of the tubers is made in a comparatively short time. When well cultivated through the growing-season this crop leaves the soil in fine condition for wheat-seeding. The fertilizers give smoother and better-flavored potatoes than those grown with stable-manure, and no other crop would pay back the original cost of the fertilizers and leave a profit besides.

This is due to the fact that the potatoes are largely *water*. Every combination of chemical and clover farming must have at least one *water* crop—something that can combine the high-priced chemicals with a large amount of cheap water, and thus make a salable product.

For these reasons Mr. Lewis is not at all afraid to shovel the fertilizer on to the potato-ground. His land grows stronger and stronger with each round of the rotation, but he has not yet reached the limit of his fertilizing. He expects to work up to 2,000 pounds per acre and make a profit on the increase. He is convinced that most failures with fertilizers are due to the fact that not enough was used. He is willing to trust his soil with \$50 worth of soluble fertilizers per acre, confident that he will get every penny of it back with higher interest than he can obtain from any other investment.

There was hardly a weed to be found in this 17-acre field, so thoroughly and carefully had the crop been cultivated. Most of it was planted with the Aspinwall planter, a few rows only of choice seed being planted by hand. Last year for the first time, Mr. Lewis used Breed's weeder and the Buckeye riding-cultivator. He gives these tools full credit for the splendid condition in which his farm was found. The weeder was kept continually at work until the vines were so high that leaves were torn off in running the tool through the rows. The whole 17 acres was "weeded" in 1½ day, with a fast-walking mule. The Buckeye cultivator is kept at work in the field when the vines become too large for the weeder, lightly stirring the entire surface and slightly ridging up the rows till the ground is as mellow and fine as an ash-heap—all ready to absorb the moisture sent by the lightest

shower. With this Buckeye cultivator a man can *ride* over the entire field in $2\frac{1}{2}$ days, doing more and better work than four men could with one-horse cultivators. Every tooth of the cultivator is under immediate control of the rider—no jerking, twisting or striking is possible. Mr. Lewis indorses the well-tested plan of making a mulch by lightly stirring the surface soil, which he is sure tends to conserve moisture. In farming with chemicals, good culture and the conservation of all possible moisture are of the utmost importance. Where the ground is fine and open, the soluble fertilizers will make use of the smallest quantities of water. The potato-beetles are fought with Paris green and water—a two-wheeled sprinkler drawn by one horse will run over the entire field in two days.

Wheat and Grass at a Second Table.

After the potatoes have eaten all of the fertilizers they need, the wheat and grass come to the table. There is food enough left to provide a full meal and they are not at all bashful about appropriating it. Sometimes a light dressing of fertilizers is put on the grass in the spring, or, when the season promises to be dry, a little nitrate of soda is put on the wheat to induce a rapid growth early in the season; but in the great majority of cases the fertilizers left in the ground by the potatoes provide ample food for one crop of wheat and two of grass. And such wheat and grass as these fertilizer fields showed! The wheat promised an average of over 30 bushels per acre, and the grass will certainly cut $2\frac{1}{2}$ tons. And this without an ounce of stable-manure and with no other fertilizers than the residue left by potatoes, which crop had already paid three times the cost of the original outlay for the fertilizers! When the fertilizers are used, such a thing as a failure to obtain a "catch" of clover-seed or grass is unknown. Mr. Lewis regards the wheat-crop as clear profit in his rotation. The straw used on the corn will pay for all the work of producing and marketing the crop, and the potatoes have already more than paid for the fertilizer. When asked why he did not raise rye instead of wheat, and sell the straw at a good price, Mr. Lewis gave several reasons. If he raised any rye he would have to put all of his grain-land in rye, as his fields are such that otherwise the grains would be mixed. Rye is not so good a seeding-crop as wheat, and he would run the risk of getting a poorer stand of grass. Sod being his substitute for stable-manure and the chief source of his humus, he cannot afford to weaken it. Again, rye is naturally a poor-soil crop. If sown after the potatoes with all this available fertilizer in the soil, it would lodge because of too rank a growth.

One great mistake that many farmers make is in assuming that grass needs no manure, but that it can take care of itself—something like a goat

or a Mexican burro. No more fatal mistake was ever made. Grass must have a supply of plant-food in some form, or it will perish. It may die a lingering death, and take more time over it than some other plants, but in the end it will fail to pay unless it is fed. It is the most appreciative crop on the farm, and grows larger, stronger and sweeter the more it is fed. Weeds thrive on hunger, but plenty prospers the valuable plants. That is to say, as soils become poorer the weeds and useless plants occupy the soil more and more. Fertilize the soil, and the grasses take fresh courage and crowd out the weeds. Nature has made this a fixed law. The wise farmer takes advantage of it by coaxing grass rather than by abusing it.

The Scavenger Crop of the Farm.

What the pig or the goose is on many farms, the corn-crop is in this chemical farming—a waste-saver, a manufacturer of the crudest materials. Every other crop on the farm is nourished by manufactured products with a view of eliminating all wastes or useless bulk. All the wastes that do accumulate are dumped upon the corn crop to be utilized, made over and fitted for the potatoes. These farmers recall with wonder their own days of manure-farming, or read the reports of other farmers who spread tons of stable-manure directly on the potato-fields. The work of hauling all the water in that stable-manure through the mud and hurry of spring, and the thought of putting that mass of hot and fermenting material directly upon the crop that is more susceptible than any other to rots and "skin-diseases," is to them incomprehensible. They can ride on a comfortable seat and put the fertilizer on 10 acres, while a big man with the stoutest team of horses in the country is hauling out stable-manure enough to give one acre a fair dressing. These farmers would not put stable-manure directly upon potatoes. It must first be "strained through a crop of corn" before they want it for making tubers. After cutting the grass for the second year, all the stable-manure made on the farm is hauled out and spread on the sod. This work is done before potato-digging, when there is nothing else to be done. In the spring, the accumulations from hog-pen, stables, etc., are scattered over the sod with straw, stalks, etc., and the whole mass is plowed and well harrowed. Corn is planted in hills; last year for the first time a little fertilizer was used in the hill. The crop is seldom or never hoed—the weeder, harrow and cultivator, used *in time*, strangling all the weeds in infancy. The corn-crop brings in less *cash* than any other, and yet it is one of the most valuable in the rotation, because it draws its fertility from substances which, in this farm system, may be counted as wastes, and because it puts the ground, the stable-manure and grass-sod in the best possible condition for the money-crop of the rotation—potatoes.

It is because potatoes *are* the money-crop of the farm, that they are petted and pampered and fed on the choicest food. The corn-plant is the key-keeper of the rotation. Clover supplies the crude material and corn "manufactures it into suitable humus" for the potato-plant—yielding its grain as almost clear gain. On a rotation of this sort, where first-class potatoes are to be grown, the corn-crop is almost as important as the clover because of its ability as a weed-cleaner, and its skill as a manufacturer of potato-humus or suitable vegetable matter to go with the chemicals to make the best "artificial dung."

The Stock—the Wastes—the Work.

Mr. Lewis keeps on his 100-acre farm two horses, two mules, four cows and two sows with their pigs. He says he has too much stock now and does not want any more! The genuine fertilizer-farmer seems to look upon stock-keeping and dairying as the worst sort of drudgery, which he is willing to leave to the farmers of the West, or to those farmers who have a love for animals and a peculiar ability for handling them. He prides himself on the fact that he is in a location where *stock-growing is not necessary to farming*; where strong sod with the addition of clean chemicals make a stronger and more enduring manure than can ever be made by "waiting on cattle" and passing high-priced grain and bulky hay through farm animals. The four cows are kept for butter and milk, a little of which is sold. They are winter-fed on stalks and corn-meal. The pigs (half Cheshire and half Duroc-Jersey) are sold in the fall. They eat up a portion of the corn and work great quantities of straw and stalks into manure. The mules have nothing to eat but ear-corn and stalks. The horses are fed hay and ear-corn or meal. No oats or other grain are ever fed; when they go off on a journey, ear-corn is always taken for feeding as they have always eaten that food. Immense quantities of straw are used for bedding, and every effort is made to rot it down quickly for use on the corn. Mr. Lewis says:

"I think it likely our system of handling these products is wasteful, and we may in time adopt some different plan if we can do so without interfering with our rotation."

It might pay him to chop all his corn into ensilage, but he does not like stock-keeping, though he believes that steer-feeding will pay better than in former years. He believes it would pay him to run all his surplus straw and stalks through a cutter merely to put them in the barnyard as they would decay more easily, absorb the liquid manure, and be more easily applied to the land. Only one hired man is kept except in haying and harvest, when extra help is needed. Potato-digging formerly demanded increased help, but they now make use of diggers, and thus save the greater part of

hand-labor. The potato-ground is cultivated so frequently and so well that at the end of the season it is in just the right shape for a digger to do its best work—a point that all farmers do not appreciate. In this system there are barely four months of hard work. After potato-digging and wheat-seeding there is little or nothing to be done until spring work opens. I have never seen a system where less *hand-work* was needed. With riding-plows, cultivators, mowers, loaders, binders and diggers, a man is in danger of forgetting how to "chase a horse over a field," or "bend his back over a hoe." "A good farmer can always find something to do," and these fertilizer-farmers are free to hunt for the labor that will bring them most profit and comfort. They are not crippled by cheap hand-labor—they give the horse a full chance in the work partnership.

This fertilizer farming offers a better chance for cooperative or community farming than any other system I know of. The farmers do not need to live far off in lonely or isolated places in order to be near and care for their live stock; their farms will not suffer if they leave them through the winter and live in villages, where society and friendly amusement may be had. A good deal of the "black side of farming" is caused by the lonesomeness of the long, dreary winters passed on some isolated farm, where, prisoned in by bad weather and worse roads, many bright and promising lives are starved by the dreary monotony of their surroundings into hopeless melancholy and bitterness. More people are tied to the dreary life by the keeping of unprofitable live stock, than from almost any other cause. Not only the fertilizers but the products of fertilizer farming can all be bought and sold in large quantities in wholesale rates without middlemen. Not only this, but as Mr. Lewis says, the habit of studying out the truth of this problem has led the farmers to investigate the merits of new machines and varieties that have largely contributed to their success.

One great advantage of this system is, that all the farm manure is used on the corn instead of on wheat or other crops. The hot summer after June is particularly favorable for the action of the chemical processes of the soil, including nitrification (changing of inert nitrogen into active nitrates and ammonia) and in converting farm-manure and all coarse materials in the soil into available plant-food. Corn, during its long summer growth, can freely use these manurial supplies. Not so with wheat, for its growth stops soon after the corn-crop has fairly started growing. When 1,500 pounds of fertilizers are used on an acre of potatoes, with wheat and grass to follow, it means only *annual* applications of less than 500 pounds. It is *concentration* everywhere. The potatoes pay for it all. While the sales of hay from this farm are heavy, this item is, as we have said, almost clear gain, because the potatoes have paid for all the fertilizer needed for three or

four years. Not only that, but they paid for it in the same year it was bought. This fact can not be too often repeated—it is the key-note of the success with fertilizers. If instead of using 1,500 pounds on the potatoes, these farmers should use 500 on potatoes, 500 on wheat and 500 on grass, their bills would be as high as now, the labor three times as great, and the crops of potatoes cut down nearly one-half, with but a small increase in grain and hay. It will thus be seen that the *rotation* is one particularly well suited to the use of chemicals. It is only fair for me to say that this system of complete manuring with rotation was devised and developed by Mr. Charles V. Mapes.*

The Record of a Chemical Farm.

Mr. Lewis's farm is old enough to be exhausted, if it is true that soil-exhaustion must follow long-continued cultivation. But his "unnatural" chemical treatment seems to give an unnatural result, for the farm persists in growing strong and more productive with each round of the rotation. It has been cultivated more or less extensively for over 100 years. During the war of the Revolution this part of New Jersey was one big battlefield. It is a part of history how Washington called upon the farmers of this community to supply his starving troops with food. This farm was then about as much a part of the "virgin soil" of the country as the newer settled parts of Iowa or Missouri are to-day. It was after the Revolution that this farm "ran down," and it ran about as far as it could.

Mr. Lewis has owned it 21 years. His immediate predecessor owned it for about the same length of time. Before that it was held for 10 years by the owner of a button-factory, who used the farm for spreading the wastes of his factory—horn, bone, etc. For 20 years before Mr. Lewis bought it the farm ran down because more fertility was taken from it in the form of crops than was put back in the form of manure. While the owner paid for the farm and made money, he did so at the expense of the soil, and left it poorer and less able to produce crops than when he took it. The practice at that time was to use marl and lime, with light applications of Peruvian guano on wheat. In those days 20 bushels of wheat per acre was considered a great yield. All the yard-manure that was made was applied to the wheat-crop, and the cost of producing a bushel of wheat or a ton of hay was greater than at present, because the yield was less and the work harder. In spite of the "war prices" of these days, yearly sales from the farm averaged only from \$1,200 to \$1,500, and crops were gradually decreasing in size.

*Mr. Lewis and his neighbors use the Mapes Complete Fertilizer.

This condition of affairs was characteristic of many other farms in that part of New Jersey; in fact, as prices for farm products dropped, and the great rush of immigration to the West opened, Eastern farmers could see little hope for the future. Mr. Lewis became convinced that, as staple farm products were lessened in price because of our immense increase in production, he must lessen the *cost* of producing a bushel of wheat, potatoes and corn by increasing the yield per acre without adding to the bill for *labor*, which on too many farms is the chief item of expense. He was not a "fancy" farmer, but looked to his farm for an income, and was thus obliged to be sure of what he was doing before investing largely in fertilizers. He learned something of the value of fertilizers by using them in a small way; but the hardest, and yet the most profitable lesson of all, was the knowledge that it paid to *concentrate* all the fertilizer needed for the crops of *four years* on the potatoes, and let them have all they needed of it. No plant or animal ever made a big record for work that was not known as a hearty eater, and the hearty *feeders* are always the men who win prizes for great crops, speed or growth. To lessen the cost of his farm products, Mr. Lewis became a *heavy feeder*, and the farm now shows its gratitude by yielding heavy crops.

In the year ending April 1, 1889, the following sales were made from this 100-acre farm:

Cattle and pork,	\$362 16
Corn,	130 00
Potatoes,	1,304 10
Hay,	925 00
Wheat,	331 22
Miscellaneous,	64 19
	\$3,116 73

In 1890, the worst season for potatoes and wheat known since the fertilizer rotation was begun, the sales footed up to \$2,435.20. The present season's sales are not completed, but will run over \$3,000, as there were 4,000 bushels of potatoes alone. The *average* income from the farm is now \$1,500 more than it was 20 years ago, in spite of the fact that the old "war prices" for farm-products were from 50 to 75 per cent. higher than are those of to-day. Not only that, but the farm is more productive to-day than it ever was before in all its known history. Mr. Lewis now grows more hay on his farm than was grown in the whole township 50 years ago! Nor is this all, for these farms have gained a reputation that is of great business value. Potatoes "grown without stable-manure" find ready sale and command a little extra price, especially in seasons when the crop is heavy. The hay from these fertilizer farms is all sold to special customers. And it is possible to develop special markets for all products grown with fertilizers—just as dairymen who call attention to the fact that they feed their cows nothing

but the purest and sweetest hay and grain, are able to command extra prices for their milk or butter. Over 250 years ago, Jethro Tull wrote in his quaint way :

This Dung is a fitter Food for venomous Creatures (*a*) than for edible Plants ; and 'tis (no doubt) upon account of this, that dung'd Gardens are so much frequented by Toads, which are seldom or never seen in the open undung'd Fields.

What can we say then to the Salubrity of those Roots themselves, bred up and fatten'd among these Toads and Corruption ? The Leaves indeed are only discharging some of the Filth, when we eat them ; but the Roots have that unfavoury infected Food in their very Mouths, when we take them for our Nourishment.

But tho' *Dung* be, upon these and other accounts, injurious to the Garden, yet a considerable Quantity of it is so necessary to most Corn-fields, that without it little Good can be done by the old Husbandry.

Dung is not injurious to the Fields (*b*), being there in less Proportion : And the Produce of Corn is the Grain. When the Leaves have done their utmost to purify the Sap, the most refin'd Part is secern'd to be yet further elaborated by peculiar Organs ; then, by the Vessels of the Blossoms, tis become double-refin'd, for the Nourishment of the Grain ; which is therefore more pure from *Dung*, and more wholfome, than any other Part of the Plant that bears it.

Scientists and practical farmers to-day do not believe this at all, but it must be admitted that thousands of city people—those who are able and willing to pay high prices for special farm products—do believe it and are ready to back up their belief in the most practical manner. Some little experience in selling potatoes grown with fertilizers has convinced me that it is possible to command a special price and trade, particularly with potatoes, by advertising the fact that "no stable manures are used." After all, Tull's idea of the value of dung for grain is not far out.

Two Cents a Pound for Manure

seems like a tremendous price to the man who uses stable-manure and never buys fertilizer. "Two cents a pound" is a bigger price than is ob-

tained for any product sold off this farm! Think of using 25,800 pounds in one year! That is what Mr. Lewis used last season, and if he has any regret at all, it is that he did not use *more*. I say that two cents a pound *seems* like a tremendous price, but when you come to figure up the *cost* of manufacturing a ton of stable-manure, you will not feel so sure about it. The payment for the chemical fertilizer is like a direct tax—you pay it all at once, in a lump, and it seems big. The cost of making your stable-manure is more like an indirect tax; you pay more, but you do not realize it because the items are all mixed up in labor, time and other things which ought to have a cash value, but which you can hardly estimate fairly. The direct tax may seem harder, but it costs less in the end, because you escape interest, dues, commissions and numberless other small items that represent the cost of making it *seem easier*. At Cornell University, it was found that a ton of fresh, sheltered horse-manure—far better than the average found on farms—was worth \$2.45, estimated just as the values of chemical fertilizers are estimated. In this ton there were just 25 $\frac{1}{10}$ pounds of nitrogen, potash and phosphoric acid—the three substances that you have to pay money for in fertilizers. In your ton of stable-manure you had 100 pounds of ash, about 450 pounds of organic matter, and 1,450 pounds of water. In order to obtain the equivalent of these 25,800 pounds of fertilizer used by Mr. Lewis, you must haul on your soil at least 300,000 pounds of stable-manure, including 210,000 pounds of useless water, and then have less potash and phosphoric acid than you have in the fertilizer. What would you charge the city for hauling 150 tons of stone? The chemical farmer trusts to the heavens for *his* water and lets the "organic matter" stand where it is organized. The question is—will the 100 pounds of ash in the ton of stable manure cost more than two cents per pound, with a fair estimate on the cost of hauling? The average stable-manure found in the farmer's barn-yard, is not by any means equal in value to that at Cornell University, because the best part of it is leached and washed out by the rains. That at Cornell was exposed to the weather just about as average farm-manure is exposed, and then analyzed again. The ton then contained only 13 pounds of fertilizing matter worth only \$1.42. This is much nearer the value of average farm-manure. It would require over 450,000 pounds of such manure to add to the land the plant-food given in the 25,800 pounds of fertilizer. What does it cost to handle and haul the 300,000 or more pounds of water in this manure? There are thousands of men keeping live stock, who admit that the sales of their animal products will not yield them 50 cents a day for their labor unless they count the manure in at its highest value, without a word said about the cost of handling it. When the price of animal products falls so low that the farmer can not figure out fair wages for himself without estimating the dry matter

in his stable-manure as worth more than two cents a pound, he had better change his plan and go to "chemicals and clover" for relief. There are farms where stable-manure will pay better than chemicals. How is one to know which these farms are? Nothing but careful figuring and experiment will show—when, including a fair price for labor, the dry matter in your stable-manure must be valued at two cents a pound in order to give you a fair profit—plant-food in chemicals will be cheaper. I do not wish to have it thought that I have arguments to make against any form of live-stock farming that is conducted on a profitable and scientific basis. Personally I prefer the dairy business to any other form of agriculture. What I argue against is unprofitable stock-keeping. There are plenty of farmers who do not love animals, or take the interest in their stock that will induce them to breed and feed it on scientific principles, because they are not stock-men by nature. Their animals are chiefly manure-makers, and are unprofitable unless an extra-high price is figured for the manure. No place on the average farm permits the loss of more actual money than the manure-pile! Such farmers not only make stable-manure at a loss, but they injure the business of the men who love live stock and are specially fitted to breed and improve it and sell its products. More Chemicals and Clover would help both classes of farmers—one because they will provide cheaper fertility, and the other because their use will diminish competition in stock products.

How many farmers have ever tried to estimate the cost of their stable-manure in this way? It ought to make a very interesting "sum" for some winter evening. Here, for example, is a statement of the crops fed on a southern Ohio farm, and the sales of animal products therefrom.

"We fed during the year to 12 cows and two horses:

25 tons of hay at \$15	\$375 00
Stalks from 15 acres of corn	50 00
600 bushels of corn at 40 cents	240 00
200 bushels of turnips at 20 cents	40 00
6½ tons of bran (bought)	100 00
One ton of linseed meal (bought)	18 00
Total value of feed	\$823 00

Value received from the above feed as follows:

3,280 pounds of butter at 25 cents	\$820 00
Four veal calves	20 00
Six heifers at \$15 apiece	90 00
Hogs	100 00
From chickens	50 00
Total value	\$1,080 00
Total value of feed	823 00
Profit	\$257 00

Eight tons of straw were also used as bedding, and entered into the manure."

Now what I want to know is, What value must be placed on the manure from these animals in order to pay the "going wages" to the farmer and his family, and leave a fair profit on the investment? What is it worth to "wait on" 12 cows, 2 horses, 10 head of young stock and 10 hogs? The same amount of labor *ought* to bring you in at least \$500 when applied to other lines of business, oughtn't it? You have no business to charge yourself less for horse or hand-work than you would charge the township for work on the road, or any "monopoly" or corporation for hauling or handling goods. I don't believe you could raise and feed those crops, and care for the stock, and make the butter, for a cent less than \$600—that is, if you had the privilege of charging *somebody else* what you really thought the labor was worth. If you do charge that and allow a fair profit on your investment, taking the above figures as a basis for figuring, those animals will be obliged to make over 350 tons or 700,000 pounds of such manure as Prof. Roberts had after exposing his manure-pile to the weather. Manure from these animals will cost a good deal more than "two cents a pound," if you pay *yourself* fair wages. I speak of these figures just as though they were your own. You should make a similar statement regarding your own business before you decide that the cost of chemical fertilizers is so much greater than that of stable-manure.

Mr. Lewis learned his lesson among the farmers on Long Island. There he met men naturally "close" and stingy, who would "look on both sides of a cent" before letting it go, using a ton of fertilizer to the acre! These men never would spend a cent uselessly, and he concluded there must be something in this heavy dressing of fertilizer. These Long Island farmers formerly used stable-manure. They were induced to use chemical fertilizers in this way. Somebody proposed that they take the same amount of money that was paid for the stable-manure used on an acre and buy fertilizers with it. They were using so much stable-manure at \$2.50 and \$3.00 per ton, that that amount bought over a ton of fertilizer. This was used on potatoes and the result with that crop was not fully satisfactory. It was not until the grass followed the wheat that the "staying qualities" of the fertilizers were developed. Then they saw the fertilizers were safe when put in the soil; that was the only thing they had been doubtful about. Mr. Lewis went home and tried this heavy fertilizing himself. On the first potato-crop the extra fertilizer did not seem to pay; on the wheat-crop there still seemed a loss; but when the grass-crop came, there could be no doubt about it! It paid. The secret of making that farm successful had been learned; and it has not been unlearned, for Mr. Lewis plans to *increase* rather than diminish his doses of fertilizers. To cut the supply would be to cut the crop.

High-grade Fertilizers like High-grade Stock.

After trying all sorts of fertilizers, the Cranbury farmers have decided that there is about the same difference between high-grade and low-grade goods that there is between well-bred and scrub stock. Starve a hired man and you weaken his back; cut off a horse's feed and he will quit in the middle of a race. A potato-plant is as exacting as a horse or a hired man, and it is just as liable to suffer from a starvation diet as either, while one advantage it has over them is that it will never eat too much. It knows when it has enough and will take up only what it can assimilate. The rest it leaves in the soil, *where it is as safe as money in the bank.*

A man is stronger, handsomer and makes a better citizen generally when fed on nutritious, digestible and well-cooked food. Sirloin-steak and green peas, bread and butter, will keep him fat, while gristle, pea-pods, bran and skim-milk cheese will barely support him. Yet these substances all come from the same materials that supply the health-giving food. The high-grade soluble fertilizer represents the steak, peas and bread; plants live and thrive on it because they can utilize it at once. The low grade, insoluble goods are like tough, indigestible food—the plant may live on it, but it can not thrive and grow to its full capacity. Sawdust and grain both come from plants, grow from the same soil and contain the same elements of food. Yet a horse will starve to death on sawdust, but keep fat and do faithful work on grain. Why is this? The food in the sawdust is not digestible and the horse cannot possibly change it into fat, muscle or force. It is inert and useless for feed. It is expensive at \$1 per ton, while grain may be *cheap* at \$25 per ton because it is digestible and the horse can utilize it at once and thrive upon it. It is just the same with plant-food as with animal-food. The high-grade, soluble fertilizers cost more per pound, but they are *worth* more because, like the grain fed to the horse, the plant can use them at *once*. There is no place in the world where *time* is of more importance than in the life of a quick-growing plant like the potato. To feed a potato-plant on a low-grade, tough, insoluble fertilizer, is like turning a cow into a rocky hill-side pasture, where the grass has been dried into wood, and expecting her to pick up food enough to pay a profit. She simply can not do it, because her whole energy and time will be spent in hunting for her food. Such a pasture given as a gift is more costly than a good clover and blue-grass pasture rented for \$2.00 per acre. The potato-plant is just like the cow. Put the soluble, high-grade fertilizer close to it and all around it and it will prosper and grow. Feed it hard stuff that it cannot digest, and you will wait long and impatiently for the profit that never will come.

"Our taxes are the same whether we use 300 or 1,500 pounds of fertilizer,"

said one fertilizer farmer. So they are. The tax on a horse is the same whether he stands still in the stable or earns his living every day. The tax on a cultivator is the same whether it reposes under a tree or is kept steadily at work in the potato-field. "If a bag of high-grade fertilizer contains 25 per cent. more soluble plant-food than a bag of low-grade, I save 25 per cent. in time and work by using the former," said another farmer. You do; and this is just the argument of the breeder of high-grade cattle, hogs or sheep—he finds a value in concentrated excellence. These comparisons may be somewhat overdrawn, but they serve well as an illustration. One man gets 300 pounds of butter per year from one cow; another has to feed two cows to get the same amount. One man may grow 300 bushels of potatoes on one acre, while his neighbor may work hard to grow the same number of bushels on three acres. The same thing has been observed with horses, sheep or any other animals or crops. It is easy to see which man makes a dollar with least work. Concentration of good qualities means crowding out waste, and in these times no business-man, be he farmer or factory-man, can afford to pay freight, cartage and labor interest on waste.

Feeding a Hungry Soil.

Mr. Lewis is fond of saying: "I will take any farm in the country that is reasonably level and has anything in the way of 'foundation,' no matter how poor it may be, and *double its producing capacity at a profit.*"

There are plenty of farmers who will agree to improve any naturally strong soil that is "worn out." They will use sheep or dairy cows, and gradually improve the soil, but there will be no money profit while they are doing it. They must look to the improved condition of the soil for the returns from their labor. Mr. Lewis proposes to improve the farm and "make money" at the same time. He will do it by using great doses of high-grade fertilizers on potatoes, and following with wheat, grass and corn. Right in his neighborhood is a farm that he takes pleasure in showing as an illustration of his method of "doctoring land." It is a "hungry" farm, if there ever was one, though it has eaten many a hard day's work, many a hard-earned dollar, many a night's rest and tons of peace of mind and health. Its capacity for eating seemed unlimited because it was never more than half fed. There are about 60 acres of naturally good land. The former owner received it as a gift—"fell heir to it." For years he tried to make a living at the old-time methods of farming, keeping poor stock, manuring the wheat, and using a little fertilizer. He could not make a living, and finally sold the place to its present owner, a young man who gave a mortgage for the whole value. That was some four years ago. When I visited the farm last year good judges said the crops

were double what they were when the farm was bought. The young man is paying off his mortgage, has painted and improved his buildings, and is gaining on his debt all the time. Last year he had 11 acres of corn, seven of potatoes, 14 of wheat, 16 of grass, and four in orchard and pasture. He keeps five cows and half a dozen sows, and "has all the stock he wants to carry." This year he used eight tons of fertilizer, and in addition seven bags of muriate of potash as, in common with many farmers in that section, he thinks his soil needs extra potash. He has not yet been through one round of the rotation, and yet his farm is paying a profit besides growing stronger all the time. This young man is "a worker." But so are thousands of others who are struggling in the jaws of a hungry farm that seems bent on devouring them. How was this hungry mouth closed? By giving it a full meal—of food that went "right to the spot"—so soluble that the potato-roots could find it at once. This young man was brought up on a fertilizer farm, and taught to believe that the soil about him was able to take good care of all the fertilizer that could be put in it. The first thing he did, therefore, when he came to his own poor farm was to try to fatten it. Men who can not force themselves to use more than "two bags to the acre," will almost shudder at the faith that impelled this young farmer to pay over \$300 cash for fertilizers and pour them into this hungry farm. \$300! That is more than the value of the entire crop grown by the former owner. It was done, however, and the effect was the same as that of a full meal on a hungry man. An empty stomach means empty courage, nerveless hands, faltering purpose—poor work. A lunch is but an exasperation. A full meal supports and stiffens every energy of mind and body, and great results are possible.

I once saw two men start work in a lumber-camp in Michigan. One had a home, of his own and had been well fed and nourished. The other had no home but had knocked about the stables and cheap hotels in Saginaw. One was prepared to exert his full strength at once, because, having been well nourished, he was in "good condition," with no feeling of "goneness" about him. The other was hungry and chilled, poorly nourished and with no provision of food stored in his body to supply the waste of muscular energy or to insure heat for the body. Without plenty of food he could not do profitable work. The first man ate a fair meal and was ready for business. The other man was "empty." He simply devoured beans, pork, potatoes and bread till the cook looked tired. Then he got up from the table, stretched himself, and went at his work like a giant. The "full meal" did it. Had he eaten no more than the other man, he would have grown hungry and weary before the day was half done. The way to get profit out of his work, was to feed him all he wanted. It is just the same with an "empty"

soil. When this hungry farm received, for the first time in years, a "square meal," it shut its mouth and went to work. It became a friend instead of a tyrant—a slave instead of a master. This young farmer says he could not have gained on his mortgage without the use of fertilizers, and the only change he would make in starting again would be to use "more fertilizers."

While at Cranbury I took particular pains to ask these farmers why they used so much fertilizer. Here are some of their answers.

Farmer L.—"When we put fertilizers on our potatoes we look forward two years to the grass-crop. That is why we use so much. For years and years we thought, with other farmers, that fertilizers were so soluble that it was only safe to put on just enough for one crop. That is all nonsense. On ordinarily level ground we find fertilizers as safe in the soil as out of it—safer too with wheat and grass coming along to make use of them. The more fertilizers I use, the more money I make."

Farmer S.—"Under the fertilizer system, my crops, grain, grass and potatoes, have fairly doubled in size. When I started the heavy use of fertilizers my father, an old man, did not think it would pay. He thought we were putting too much cash 'into the ground.' The old plan was to apply just as much fertilizer as a single crop could use and no more, as it was thought that what the crop left would be washed out and wasted. So 400 or 500 pounds per acre were all they dared to use. My father could not see how all the money spent for 1,500 pounds could come back. He lived long enough, however, to see such an increase in the crops that he was convinced that the heavy fertilizing pays. I am sure the only way to make fertilizers pay is to use lots of them. *I do not know of a single farmer who has worked up to 1,500 pounds, who would ever go back to a smaller quantity.*"

Farmer D.—"I have used fertilizers for five years. I use 1,500 pounds per acre on potatoes. My wife sometimes complains about the amount of cash I spend on fertilizers; but my experience is that the more I spend in this way, the more, proportionately, I get back. Last year I sold \$1,100 worth of hay. I have 100 acres of land. Our farms are assessed for the same amount whether we use 400 or 1,500 pounds per acre. If by using 1,500 pounds we can double our crops (and we have done so), it is good business policy to use the larger amount."

It is evident that a hungry soil can not feed itself and have any strength left for paying a profit. Simply put back in the form of manure the crops that are grown on that soil, and the gain will not be rapid enough to pay for labor and taxes. Buy grain to feed to live stock, and leave the manure on the farm, and the farm will improve, but will it *pay* while improving? Is the grain cheaper than fertilizer would be? That is the point to figure on.

Many "authorities" tell us that poor land can be brought up to a productive point—that is, to a condition that will insure a good crop of clover at any time—by the use of green manures *alone*. This may be true in some cases, but not in the majority, and in any event the process is slow and tedious. One of the best experiments conducted in this line was that of Mr. L. D. Davis, of Rhode Island. Mr. Davis took a run-down "abandoned" farm and attempted to improve its condition by means of green crops alone. First rye was sown early in September. This made a fair growth, which was plowed under in June and the field seeded to buckwheat. In September the buckwheat was plowed in and another seeding of rye given. This rye grew better than the other, and in the following June this growth was plowed in and a seeding of millet given. The millet was plowed under in September and rye with Red-Top and Timothy sown for a permanent crop. The yield of rye was only fair even after all the labor of growing and plowing in four different crops, while the soil was not in condition to make sure of a catch of clover. Mr. Davis wisely concludes:

"1. That it is not wise to depend on this process alone for fertilization. Though often told that plowing in green crops restores all the elements of fertility in the proper proportions needed for future crops, I am satisfied that they do not in all cases meet the demand even in that direction. All poor soils are not sterile from the loss of precisely the same ingredients, and all green crops do not hold the several elements of fertility in the same proportions, whatever may be said to the contrary. And so, as a matter of fact, it requires as much skill to adapt growing vegetation to particular soils as it does to use special fertilizers profitably under similar conditions; and for this reason many of the claims that have been put forth for green manuring from time to time are quite too broad and comprehensive.

"2. The time required to produce the desired results by green manuring alone is altogether too extended. In this case two full years and four crops turned under, together with much plowing, harrowing and seeding, made but a beginning; and at the same rate of progress it must have taken several more summers to have produced very marked results. I doubt if the land had yet reached a point where a fair growth of clover could have been secured to be used to advantage in the same way, or otherwise.

"3. The application of other fertilizers should accompany green manuring—first, because they will give a larger and richer crop to be turned under, and secondly, because they will hasten the period when the desired results will be attained. To the farmer as well as to the banker, time is money, and if the enrichment of the soil requires three or five years by one process and but one or two by the other, the difference in expense will be found much greater than is at first supposed.

"4. And so I should not again attempt to reclaim barren land by green manuring alone. My experiences with green manuring and chemical fertilizers together were far more satisfactory."

This trying to farm poor land with green manures alone, is just like trying to winter a dairy cow on hay or straw. It is folly to expect her to pay a profit on such food. She simply can not do it, because she can only give back in the pail a part of what you put in her mouth. She must have *feed*—grain; hay alone will not answer; and grass alone will not answer for the hungry soil—it must have something stronger.

A Substitute for Stable-Manure Possible.

What is stable-manure? Waste. Feed an animal hay or stalks and grain; a portion of the food is used to maintain life and make growth—the rest passes through the system as waste. The same elements that make the grain valuable as food are found in chemical fertilizers. It is true that an animal could not live on chemical fertilizers—though travelers in Sweden tell us how, in the colder parts of that country, the cows are trained to eat the horse-manure, and sustain life on it, with the addition of a little grain. Another curious instance where animals feed on "plant-food" is found in Connecticut to-day, where some cows and sheep are fed regularly through the winter on salted fish! When the Pilgrims first came to Plymouth they hired an Indian to show them how to plant corn. He caught great quantities of alewives or herrings, and put one in each hill of corn to serve as a fertilizer. Now this same kind of fish is fed to cows and sheep with apparently good results. Animal-food differs from plant-food only in form. The feeding-organs of the plant take the plant-food and combine it with water, fats, starch, and other substances, and make animal-food out of it. Before this animal-food can serve again as plant-food it must decay and be acted upon by heat, water and acids. When hay is fed to animals a part is digested. The waste of this digested portion passes away in the urine. The solids of the manure are *not* digested. They are simply ground up finely and softened by heat, water and the acids of the animal system. It is the same with grain. The *digested* part of it is excreted only in the urine, which is *soluble* plant-food. The plant-food in chemical fertilizers is also digested, because it has been acted upon by strong acids and other powerful reducing agents. It, therefore, supplies better and more soluble plant-food than is found in the grain fed to animals. In what way is hay improved, as manure, by passing it through cattle? In Florida linseed-meal is put directly in the soil, and makes a good fertilizer. In parts of the country bran is used to grow potatoes. An Orange-county cream-man puts skim-milk directly upon his grass. A good illustration of the difference between plant-food and

animal-food is given in the use of cotton-seed meal. This substance is used both to feed animals and as a fertilizer. To the southern farmer it is the cheapest and most easily obtainable form of nitrogen, because it is a waste of a home-grown product, easily applied, good to mix with other manures, and "more lasting" in the soil than some mineral forms of nitrogen when drenched by the heavy southern rains. At the north this same product is one of the greatest of boons to the dairyman. It is a "concentrated" food, and thus makes a fine addition to ensilage, straw, roots or other foods that are "bulky" from an excess of water or useless fiber. But let this cotton-seed meal that is to be fed to stock become damaged by water, heat or other causes so that it becomes discolored, and its value as a stock-food is destroyed. It is no longer safe to feed it to cattle, even if they would eat it. But while this slight change spoils it for stock-feeding, it is just as good for use as a fertilizer as it ever was, giving probably as quick and sure results as though it had been fed to animals and excreted as manure. All farmers have seen damaged grain of various kinds that had been burned, "heated" or wet. The stock will not eat such grain, and it would not be considered safe to feed it to them anyway; but any farmer knows it will make good manure, and that if he puts it right on the manure-pile and works it in well, the manure will be as strong as it would have been had he fed that much more grain to his stock. And he would have received the manurial benefit of the damaged grain if he had simply put it on the ground to be cultivated without working it into the manure-pile at all. The benefit might have been somewhat slower, because unquestionably the fermenting processes that go on in the manure act to render the insoluble plant-food more soluble, and consequently more active; but what I say is that none of the *fertility* in the grain will be lost because it has not been eaten by animals. Several years ago a Connecticut farmer had a chance to buy a car-load of damaged corn-meal, weighing 56,000 pounds, for \$50. A sample submitted to the Connecticut station contained nitrogen, potash and phosphoric acid worth \$5.16 per ton. Dr. S. W. Johnson said of it: "This meal has about twice as much nitrogen as good stable or yard-manure, and this nitrogen is doubtless at least twice as available or effective as that of stable-manure; it also contains nearly the same proportions of phosphoric acid and potash as stable-manure. Heavy applications would, for a time, greatly improve the texture and water-holding capacity of light, sandy soils." Thus we see how easily animal food is changed to suitable plant-food. My cows frequently pull clover-hay out of their racks and trample it under their feet. They will not eat it then, or will they eat the hay which the "next cow" has "mussed over" and breathed upon. This spoiled hay goes into the manure. Why, aside from the fact that it is not chewed and

ground up into very fine particles, is it not as good manure as the rest of the hay from the same rack, which was eaten and excreted? In fact, is it not better? I have given these illustrations to try and make clear the fact that it is not absolutely necessary to feed grain and hay to live stock in order to "work them into plant-food." The most that animals do is to take out the greater part of the *fats* in our grain and hay and make them over into new forms so that we can sell them. These *fats* are good for nothing as manure; when sold in the form of animal products, do they bring in enough to pay for all labor and the interest on the investment?

The ancient idea was, that animals added a value to the food they took into their mouths; in some mysterious way they were supposed to grow and thrive on the food, and still make the hay worth more as manure than it was before it was eaten. These same folks believed that plants *developed* lime, potash and phosphoric acid, as a result of vital force. One idea is as sensible as the other. We know better now. The simple question is this: Does sun-cured grass fed to cattle, make more valuable manure than the same grass permitted to decay in the field, and acted upon by rain, sun and frost? In other words, Are heat, sun and frost as valuable "reducing agents" as the forces of living animals? The fertilizer farmer claims that there is substantially little difference in the manurial value of grass acted upon by nature's forces and that fed to and excreted by animals. He also claims that his chemicals supply more and better plant-food than can be obtained for an equal value in grain. Chemicals and clover put together in the field, give as strong manure as can be hauled out of any barnyard, because they supply the same elements that are bought in hay and grain. More than this, it has been abundantly proved that not one-half of the fertility in stable-manure is *available* for a quick-growing plant, while practically *all* of the high-grade fertilizers can be used at once. It is true that many failures have been made with green manuring on poor soils. That was because the farmers did not realize that green crops *alone* did no more for the soil than good hay alone would do for a dairy cow in winter. It might keep her in good health, but she could not give a profitable mess of milk until she had *feed*. In the same way the land needed *feed*—more fertility than there was in the green crop. Not chemicals alone, not clover alone, but chemicals *and* clover, are the secret of Mr. Lewis's success. Rye has been suggested as a substitute for the clover in the rotation. It has also been claimed that potash and phosphoric acid alone will answer as well as a "complete fertilizer." Mr. Lewis does not favor either change. The chief value of the clover lies in its *root-action*. It "digs deep" while rye-plants sleep. It catches and retains fertility far down in the soil, and is the best "nitrogen trap" in the world. As to "complete fertilizers," a

farmer may feel *sure* of them—potash and phosphoric acid alone make at best but an experiment. The crop *may* fall off in yield for want of the missing nitrogen. All farmers recognize the great value of clover. Those who advocate the use of rye or other green crops in the place of clover are generally in sections where, for some reason, the latter plant is not sure of a "catch." For example, a writer in *The Rural New-Yorker*, living in Delaware, said :

"Green rye adapts itself easily to poor circumstances, and will make a good crop and is a cheap manure, costing only for seed and the time of planting and plowing, and it is there on the land when needed to be turned under early or late in the season, as the case may be. Hence my claim for green manuring with rye instead of clover, the late maturing of which causes the loss of the season, except for wheat or a late planting of potatoes, Clover with us, while a moderately sure crop, is not always certain; the last two seasons it has failed to catch, except in places—another reason for my advocacy of green rye. Clover is undoubtedly the richer in fertility, but the drawbacks to it entitle green rye to the first place."

This man proposed to grow potatoes, wheat, timothy, corn and rye, and to use bone and potash, plowing in the rye for the potatoes. This is a partnership of "Chemicals and Rye." In this partnership "Chemicals" has less capital because it lacks nitrogen, while "Rye" is weaker than clover, both above and below ground.

Mr. Lewis, I believe, does not go so far as to say that clover is absolutely necessary to the success of his rotation, but he does say that clover is better than any other plant, and that it will pay one to go to any reasonable expense in the way of draining and tillage to insure a perfect "catch." Clover never fails on these heavily-fertilized farms, while it frequently *does* fail on lands less carefully cultivated. It is evident that land must be in "pretty good order" before clover will grow upon it. Rye is probably more of a "rustler" than clover, but the latter does twice the work for the farmer who will take pains to coax it.

Chemicals and Clover vs. Steers and Stover.

On another page I have given the figures, showing what Mr. Lewis sells from his 100-acre farm. Here are some statements from farms where stable-manure is the basis of fertility. The farmers who make them are enterprising and energetic men—far in advance of the practice and profits of their neighbors.

First is a statement of what was sold from a 200-acre farm in western New York, within thirty-five miles of Buffalo. On this farm are kept forty

sheep, twelve cows and several horses. This farmer bought \$250 worth of feed during the year :

Wheat	\$170 00
Barley	160 00
Beans	590 00
Potatoes	70 00
Hay	60 00
Wool	40 00
Lambs and sheep	100 00
8,000 gallons milk to Buffalo	720 00
Calves	12 50
Pears	6 00
Total	\$1,928 00

Now comes the business record of an Indiana farm of 200 acres—140 tillable—within twenty-five miles of Chicago. On this farm are kept eighteen cows, the same number of hogs, and twelve horses and colts :

1,159 cans milk (8 gallons per can)	\$772 15
5 cows	115 00
13 veal calves	50 70
16 hogs	165 70
chickens and eggs	37 40
41¾ tons of hay	243 96
34¾ bushels wheat	293 79
388¾ " rye	174 30
566-7 " corn	29 91
183¾ " potatoes	161 70
16 cords wood	48 00
Total	\$2,092 61

This is what was done on a 160-acre farm in Central Illinois—a farm that carries about thirty head of cattle, twenty hogs, ten horses and fifty sheep :

Winter wheat	\$185 78
Hay	37 70
Apples	58 50
Hogs	457 75
Sheep and wool	306 10
Cattle	200 00
Horse	95 00
Butter	85 00
Total	\$1,425 83

The sales from this farm were smaller than the average, as a large stock of annuals were left to be carried over. It is not likely that Chemicals and Clover would pay better than stock here, but the sales are useful for comparison.

Or take this record of an Iowa farm of 100 acres, on which are kept fifty-six cattle, sixty hogs and nine horses.

3,019 pounds of butter, which brought, after deducting freight, tubs and commission	\$497 02
Eight steers	453 37
Four cows and heifers	99 38
44 hogs	453 22
Hay	46 07
Poultry and eggs	43 68
Honey	16 34
Total	\$1,609 08

From this should be deducted :

For corn bought and fed	\$229 67
For oats	28 35
Total	\$258 02

Now, in what way is this farm in "exhausted" New Jersey inferior as a profit-payer to these excellent stable-manure farms? There is less work, less worry, and less waiting, in the firm of Chemicals and Clover than in the partnership of Steers and Stover.

Water is a Good Thing to Sell,

but a poor thing to buy. A "chemicals and clover" rotation can not pay unless there is one crop in it that is largely *water*. The potato-crop is admirably suited to this rotation, because it is seventy-five per cent. water. The plants take the high-priced fertilizer and mix it with cheap water, so that the farmer is able to sell tons of the cheapest substance in the world. Just consider this a moment. In the 4,000 bushels of potatoes that Mr. Lewis sold this year were 180,000 pounds of water, for which he obtained over one-half cent per pound. The water was given to him. His part of the business was to have on hand strong thrifty plants, capable of combining his soluble fertilizers with this free water. That man in New York state, with his 8,000 gallons of milk, only sold about 75,000 pounds of water, while the Indiana dairyman sold but little over 80,000 pounds. The water in the potatoes was handled perhaps six times, and almost entirely by machinery. The water in the milk was squeezed out of the cows at 730 different times during the year. Other water-plants that can be used are tomatoes, cabbage, beets, melons or berries. I know of men who are growing all these crops in this same rotation of grass, corn and wheat. Water, heat, air and sunshine are the great gifts of nature to the farmer. We can not sell air because it does not weigh enough to bring a price. We sell heat in the form of fats and starch in our hay, grain and potatoes, but we do not get full price for it because it must be manufactured and made into new

forms before it can warm the body. Sunshine we can not sell, as we can not measure, weigh or estimate its value. Water, the freeest and most abundant gift of all, we *can* sell all made up—ready for use.

What a Hill Farmer Thinks of It.

Mr. J. W. Newton is a Vermont dairyman. His is a natural-pasturage farm, too hilly and rocky for chemicals and clover. Yet this does not prejudice him. He sees the advantages of this system, as he has said in *The Rural New-Yorker*: "Just think what a saving it would be to have no manure to handle, no pasture-fences to keep up, no milking to tie one down at home, no milk and cream and butter to handle! What a vast amount of labor the new system saves! I hope a great many of the farmers in the thickly settled regions will adopt this new departure. We poor farmers who live back among the mountains and hills must keep on milking and hauling manure; and the fewer cattle kept, the better will cattle-raising and dairying pay those who keep stock. Our fields are better suited to cattle and sheep than to grain-growing, and we can not well get along without stock.

"If a man makes more than the average farmer, he must get out of the rut in which the average farmer moves. He must make a better article, or put it up in better shape, or produce it at a season when prices are higher, or make it at a less cost than his neighbors in order to get a better price. All this requires skill, and on top of this he needs business ability to keep his profits from the clutches of the middlemen. Now, butter-making requires as much skill as the other branches of farming, or more, in order to make it a success, but it is confining work.

"Is farming with chemicals and clover going to solve the labor problem? It ought to where it can be adopted. It takes lots of time to milk on a farm, lots of hard work to care for the manure, lots of expense to keep up fences. A man who has to milk ten or a dozen cows twice a day can't do much farm work before breakfast or after supper. If I could only get rid of every animal on my farm except the team and the family cow, wouldn't it be nice? I could get at some of the jobs that are waiting to be done, and which, as things are, will have to wait a good while longer.

"Perhaps not every farmer can grow potatoes and wheat, but most can grow clover, and they can find other money-crops to grow instead of these. But the outlook for wheat is very good, and potatoes are high once in two or three years, as a rule. If a man tries, he can grow crops which he thinks are not fitted to his soil. A few years ago I was almost discouraged about growing potatoes; but I have been learning more about it every year; last year I had the best crop I have ever grown."

Chemicals, Clover and Sheep.

An Ohio farmer, Mr. O. G. Williams, writes that he has been carefully feeling his way towards chemicals and clover. He then says: "The question has occurred to me, What is the most profitable use that can be made of the clover hay grown in this rotation? To friend Lewis and others who are following this system of farming I should like to suggest the keeping of sheep. Some live stock must or ought to be kept. The great objection to keeping cows in connection with grain and vegetable-farming is the extra work required. Dairying is a business of itself. The fattening of steers has long since proved unremunerative. I know of no live stock better calculated to fit into this rotation than sheep. By keeping the mutton breeds and raising early lambs the extra work involved will come at a season of the year when there is most leisure. February or March is a good time to have the lambs dropped. Without any extra help one can add materially to his income in this way. The surplus coarse feed grown can be profitably consumed by the sheep—more profitably, I think, than any other kind of live stock, considering the work required. But what about pasturing them? If one has no permanent pasture, it is possible in most localities to hire pasture-lots at quite low rates. Perhaps pasturing the clover one year may be desirable. In case of inability to get sufficient pasture, February lambs can be sold in May and the sheep can follow them soon if fed liberally on grain, and another flock can be purchased the following winter. Formerly I kept a few cows and sent the milk to a cheese-factory—the system of dairying in vogue here—but am convinced that more money is to be made from mutton sheep with much less labor. They make a desirable stock and insure an income twice a year—from wool and lambs. Some localities are not favorable to sheep, but where they do well I think they will make a valuable addition to the firm of "Chemicals and Clover."

Mr. Lewis has a farm on which there is practically *no* waste land; it is all capable of high culture except a small wood-lot. If he had any waste land or any land so situated that it would make better pasture than a clover-sod he would keep sheep. As it is, more live stock would simply interfere with his rotation. He has not the buildings, pastures or fences needed for keeping stock. He can now sell his prime clover-hay to dairymen for enough to make it pay. He estimates that the profit of stock-keeping less the price he now obtains for the hay, would not pay him for his work. At the same time he believes that Mr. Williams is correct, and that it will pay *him* to sell his clover-hay to sheep rather than to a commission-man. The result will be stronger, and better corn and consequently better potatoes, grass and wheat. In no case would he use a lighter dressing of fertil-

izers. There can be no doubt that nine out of ten failures with chemicals are due to the fact that the farmer did not use enough of them. There are also places on many stock-farms where chemicals and clover would pay. On my own farm in New Jersey, some of the best land was at the top of a steep hill over half a mile from the barn. It would be folly to try and haul stable-manure up that steep hill. I can take, in one load of fertilizers, all the fertility there is in fifteen loads of stable manure, and I can grow clover on the ground that is fully equal to any hay that can be fed to stock. The crop on this high land may all be hauled *down hill*, while the manure must go up hill. Water in stable-manure or in anything else will never run up hill, but it will slide *down* with ease. Short hauls for stable-manure. Plenty of outlying fields are neglected and deserted because it does not pay to haul stable-manure to them. These are the fields for chemicals and clover., even when the farm is crowded with live stock.

There are many stock and dairy farms whose owners, past middle age, have no need to work and worry over the care of animals. At the same time they feel that the stock must be kept, or the farm will run down. Such farms may be given up to the production of hay, and maintained for years by the application of fertilizers alone. If the grass crop did fail for any reason, it could be seeded anew with grain and clover, using fertilizers with the grain. Annual dressings of fertilizers would render stable-manure entirely unnecessary.

The Substance of the Matter.

I look upon this chemicals and clover farming as the best illustration I have seen of the possibilities that lie within the reach of the American farmer. I do not believe that any stable-manure farm in the country, of 100 acres, can show larger sales of the four staples, wheat, corn, potatoes and grass, or show one-half the *profit* in time and money that chemicals and clover make for Mr. Lewis. These are strong statements; but they are made with confidence. Farmers may well ponder them. Science is rapidly freezing the "old rut" over. The man who sticks inside it until the crust hardens over him is beyond the help of love or legislation.

The chemical farmer has the following creed: "*Supply a full meal of the cheapest manure to the best plants of the crops that suit your market and farm.*" Chemical fertilizers for these Cranbury farmers, are cheaper than stable-manures, for several reasons:

1. Meat-making does not pay, and the cost of hauling and spreading city manure is too great.
2. The plant-food in chemical fertilizers is more available and better suited to the wants of the potato-plant than that in stable-manure. It costs

less than the grain that must be fed to stock to give stable manure any value. Strong clover-sod, with chemicals fed directly to the soil, gives better, cleaner and cheaper manure than clover-hay and grain fed to farm animals.

3. On compact, level soils fertilizers are as permanent as stable-manure. No rain can wash them so far into the soil that the roots of a clover-plant cannot follow and capture them. Without clover they might be lost; with clover, never. The one thing that has done more than anything else to keep farmers from using chemicals is the belief that they will "wash out" of the soil and be lost. That this is nonsense has been proved by scientific experiments time and again; but the most eloquent refutation of the charge is offered by the wheat, the Timothy and the clover that follow the potatoes without an ounce of additional fertilizer. The man who is afraid to trust his soil with a "full meal" should get out of farming as quickly as possible, because his farm will repudiate him—and serve him right.

I have said that farming with chemicals and clover is special farming. I repeat it. A farm must possess certain natural characteristics in order to make this system profitable. It must be level, or nearly so, well drained, easily tilled, capable of growing clover, near a good market, and with a fair proportion of naturally good potato-ground.

The best way to *start* such a system would be with the corn-crop, using all the stable-manure possible, and following with potatoes, using 1,200 or 1,500 pounds of fertilizer per acre, with wheat and grass to follow. The more fertilizer used, the cleaner and more careful the needed cultivation. Where the soil is kept constantly stirred and loosened, a very light shower will show an effect on the plants at once—quicker than if stable-manure is used.

A system of chemical-farming must include some crop that is largely water which makes quick growth, sells at a good price, and can give a large crop per acre and utilize most of the nitrogen in the fertilizer. With the majority of farmers, potatoes will fill this place better than any other crop.

Chemical farming will pay in any locality where the cost of chemicals and clover-sod is less than that of the manure made from clover or other hay and grain. The common objection to chemical farming grows out of the fact that this comparison of manure-cost has never been fairly made. What the farmer wants to study out is the comparative cost of the nitrogen, potash and phosphoric acid in stable-manure as compared with their cost in the fertilizer. Hundreds of farmers now realize that it pays them to sell their whole grain and buy waste or by-products like bran, shorts or oil-meal. The chemical farmer has gone even further and found that it

pays him to *sell* his nitrogen, potash and phosphoric acid—combined with *water*—in the finished state, and *buy* them *dry* in the crude state.

We are on the eve of a wonderful development in scientific farming. Driven by ambition, by scientific investigation, or by poverty, farmers are coming nearer and nearer to the truths that underlie a rational and profitable treatment of the soil. The faith that one inch added to the tillable depth of one acre of land is worth more than the whole surface of five new acres, is the rock upon which American agriculture must fasten itself. There is hope and prosperity in the future for the farmer who will be true to his farm. No naturally good land within reasonable distance of a market need ever be turned out as a pauper or helpless cripple.



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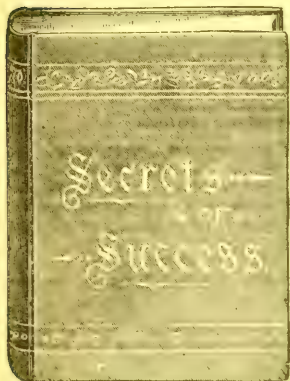
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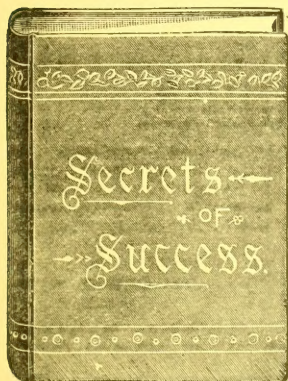
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"We are using the Weeder to-day on a field of potatoes a foot high, and it does the best work it has done yet, for we have hit just the right condition of the soil."—WALDO F. BROWN.

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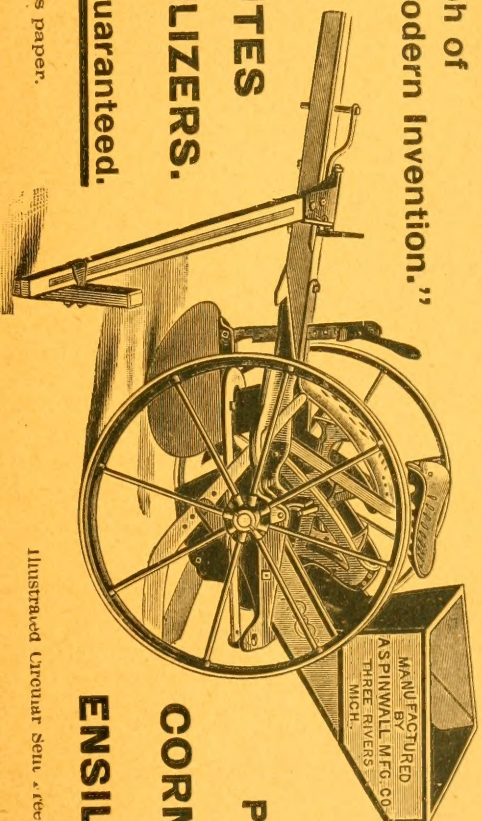
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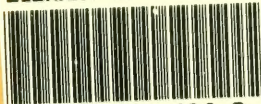
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